9 Sediment Investigation Results

This section presents the results of sediment investigations in 1993, 2001, and 2002. Groundwater at Skykomish generally recharges the two surface water bodies in the study area; the South Fork of the Skykomish River and the former channel of Maloney Creek (Figure 1-2). Sediment samples were collected from the South Fork of the Skykomish River and the former channel of Maloney Creek during the initial RI and the Supplemental RI field investigations to fill data gaps and respond to public concerns. The objectives of the sampling were to assess the extent and nature of contamination in sediments in the river and Maloney Creek, to determine whether contamination, if present, is associated with the former maintenance and fueling facility, and to collect enough information to develop remedial alternatives for sediments affected by the former maintenance and fueling facility. This section presents the results of the sediment investigations along these two water bodies.

The first sampling event was conducted during the initial RI in October 1993, when sediment samples were collected from seven stations in the Skykomish River and former Maloney Creek channel. The second (pre-Supplemental RI) sampling event was conducted in July 2001, when samples were collected from six stations in the Skykomish River. The third sampling event was conducted during the Supplemental RI fieldwork in December 2001 and January 2002, collecting sediment samples from eight stations in the former Maloney Creek channel. Samples were collected at these 21 stations from various depth zones to characterize the vertical extent of sediment contamination.

The depth to groundwater is very shallow along the creek bed at certain times of year and groundwater is present in the creek bed when groundwater levels are at their highest. Therefore the smear zone could be considered to extend to the ground surface. However, to be partially consistent with the soil samples grouping, the sediment samples were divided into two depth zones, the surface zone and the smear zone. The vadose zone is absent from the former Maloney Creek channel bed. Although groundwater may be present within the surface zone, when the groundwater levels are high, the contaminant concentrations increase below approximate depths of 2.5 feet in contaminated areas, and therefore the top of the smear zone has been defined as 2.5 feet along the channel bed. The depth intervals for samples collected from the former Maloney Creek channel are indicated below:

- Surface soil: 0 – 2.5 feet; and
- Smear zone: 2.5 to 10 feet.

9.1 Sediment Data Collection

9.1.1 Initial RI Sediment Data

Sediment samples were taken from seven sampling locations on October 7, 1993 during the initial RI fieldwork. Five of the sample locations were along the south bank of the Skykomish River west of the 5th Street Bridge and two of the sample locations were in the former channel of Maloney Creek. Samples SED-1 through SED-5, from the river, are outside the rail yard while samples SED-6 and SED-7, from Maloney Creek, are within rail yard boundaries. Sediment samples were analyzed for TPH (EPA Method 418.1), SVOCs (EPA Method 8270), VOCs (EPA Method 8240), metals (EPA Method 6010/7060), and PCBs (EPA Method 8080). Results are discussed below for each parameter. Figure 3-3 shows the sediment sampling locations. Laboratory reports are presented with soil data in Appendix E.

9.1.2 2001 Petroleum Seep Data

Surface sediment samples were collected from the banks of the Skykomish River on July 10, 2001 from four seep areas (SED-11, SED-12, SED-13, and SED-14), a downstream site (SED-10), and an upstream station on the north bank of the Skykomish River (SED-16), which is considered the reference location (Figure 3-3). The sediment samples were analyzed for TPH (Method NWTPH-D), sulfide, ammonia, total organic carbon, total solids, and total volatile solids. Only the TPH results are presented below; all results can be found in Appendix E. These sampling locations are all located outside the rail yard. The analytical results of seep sampling, including conventional parameters and grain size, were presented in a letter to Ecology on December 7, 2001 (RETEC, 2001c).

9.1.3 Supplemental RI Data

During the December 2001 and January 2002 sampling events, eight stations were sampled. Six stations were sampled along the southern edge of the rail yard covering roughly 700 feet along the former channel of Maloney Creek. Stations 2B-SD-1 through 2B-SD-6, with the exception of 2B-SD-3, are located on the rail yard. Station 2B-SD-3, as well as stations 3-SD-1 and 5-SD-1, is located outside the rail yard (Figure 3-3). Between one and four samples were collected at different depths at each of stations 2B-SD-1 through 2B-SD-6. One station was sampled at the end of a side-channel of Maloney Creek (3-SD-1) at a single depth. Station 5-SD-1 was located in a drainage ditch at the western end of West River Road and sampled at two depths (Figure 3-3). Sediment samples were collected as described in Section 3.3 above and analyzed for TPH (Method NWTPH-D), PAHs (EPA Method 8270-SIM), VOC (Method VPH), metals (EPA Method 6010/7060), and PCBs (EPA Method 8080). Sediment sampling results are discussed below and laboratory reports are presented with soil data in Appendix E.

The sediments of the former channel of Maloney Creek, sampled in 2001 through 2002, generally consisted of a layer of organic silt (up to 10 inches thick) above a sometimes-gravelly sand unit (up to 7 feet thick) underlain by the gravel unit described in Section 6.1 above. The gravel unit was not penetrated during sediment sampling and as such, no thickness is available; however, lithologic data discussed in Section 6.1 above indicate that the gravel is continuous on both sides of the creek and is underlain by the silt unit described in Section 6.1.2.

9.2 Total Petroleum Hydrocarbons

Results of petroleum hydrocarbons in sediments are shown on Figures 9-1 through 9-4 and presented in Table 9-1. A total of 20 samples were collected and analyzed for petroleum hydrocarbons in the surface zone (14 outside the rail yard and six on the rail yard). Eight samples were analyzed in the smear zone (three outside the rail yard and five on the rail yard); and two samples were analyzed in the saturated zone (one in each area).

The maximum diesel-range TPH concentration was 48,000 mg/kg, and the maximum motor oil-range TPH concentration was 39,000 mg/kg, both of which occurred at SED-13 within a petroleum seep along the Skykomish River, and which are approximately seven times higher than the next highest concentrations. The average diesel- and motor oil-range hydrocarbon concentrations were 2,739 and 2,483 mg/kg, respectively. Concentrations were generally highest in the smear zone of samples collected along the former channel of Maloney Creek, with the exception of SED-13.

The following elevated TPH concentrations were measured in the sediments collected along the former channel of Maloney Creek in the smear zone (in December 2001 and January 2002); SB-SD-4 (maximum of 1,700 mg/kg, motor oil) and SB-SD-5 (maximum of 6,200 mg/kg, motor oil). Co-located groundwater wells were installed (2A-W-9 and 2A-W-10, respectively) to identify a potential source of sediment contamination. Well 2A-W-9 measured diesel-range TPH at 0.54 mg/kg, and motor oil-range TPH below the detection limit. Well 2A-W-10 did not detect TPH (Table 8-1). The groundwater data, together with the plume identified under the general region of the former channel of Maloney Creek (Figure 8-4), suggest that groundwater contamination is a potential source of TPH in sediments in Maloney Creek.

9.3 Metals

The results of laboratory analysis for metals (arsenic and lead) in sediments are shown on Figures 9-5 and 9-6 and presented in Table 9-2. A total of 13 samples were collected and analyzed for arsenic and lead in the surface zone (eight outside the rail yard and five on the rail yard); and seven samples were

analyzed in the smear zone (three outside the rail yard and four on the rail yard).

The maximum arsenic concentration in sediments was 50 mg/kg, measured at SED-2 (1993) along the Skykomish River. The maximum lead concentration was 69 mg/kg, measured at 3-SD-1 (2002) in Maloney Creek outside the rail yard, grid Section 3. The average concentrations of arsenic and lead were 9 and 20 mg/kg, respectively. In general, metals concentrations measured in all sediment depth zones across the site were consistent with background soil data discussed in Section 7.2 above.

9.4 PCBs

PCB analysis was completed on 12 sediment samples collected outside the rail yard; eight surface zone samples, one vadose zone sample, two smear zone samples, and one saturation zone sample. PCB analysis was completed on eight sediment samples collected within the rail yard; five surface zone samples (one was an Ecology split) and one sample in each of the vadose, smear, and saturation zones. Results of PCB analyses are shown in Table 9-3. No PCBs were detected in samples collected by RETEC. Ecology detected Aroclors 1254 and 1260 at 0.0035 and 0.0038 mg/kg, respectively, in one surface zone sample from Maloney Creek within the rail yard (2B-SD-1). Both values were qualified as estimated concentrations.

9.5 PAHs

PAH analysis was completed on six sediment samples collected outside the rail yard; five surface zone samples and one smear zone sample. PAH analysis was completed on five sediment samples collected within the rail yard; three surface zone samples and two smear zone samples. Results of PAH analyses are shown in Table 9-4. Outside the rail yard in Maloney Creek, PAHs were detected only in 2B-SD-3; benzo(b)fluoranthene (0.01 mg/kg), benzo(k)fluoranthene (0.018 mg/kg), chrysene (0.054 mg/kg), and pyrene (0.017 mg/kg). This sample was in the smear zone at a depth interval of 7.5 to 10 feet.

Within rail yard in Maloney Creek, PAHs were detected in three samples. Ecology detected 16 PAH compounds in its split sample from the surface zone. The other two Maloney Creek sediment samples from the rail yard with PAHs were from the smear zone; 2B-SD-4 (13 out of 16 PAH compounds detected), and 2B-SD-5 (6 out of 16 PAH compounds detected, including anthracene, benzo(a)anthracene, chrysene, fluoranthene, phenanthrene, and pyrene. Benzo(a)pyrene results are shown on Figure 9-7.

9.6 BTEX and EPH/VPH

BTEX and EPH/VPH analyses were completed on six sediment samples collected outside the rail yard; five surface zone samples and one smear zone sample. BTEX and EPH/VPH analyses were completed on three sediment samples collected within the rail yard; two surface zone samples and one smear zone sample. BTEX results are shown in Table 9-5. BTEX was not detected in any sediment samples.

Table 9-6 shows the results for sediment samples analyzed for hydrocarbons by the EPH and VPH laboratory methods. There were two samples analyzed for EPH and VPH, 2B-SD-3 (outside rail yard) and 2B-SD-4 (rail yard), both of which were collected within the smear zone. The aliphatic and aromatic compounds between C10 and C34 were detected in both samples (except aromatic C12–C16 in 2B-SD-3) with concentrations increasing with increased carbon chain length.

Two aromatic compounds were detected by the EPH method in 2B-SD-3 at concentrations of 83 and 280 mg/kg for C16–C21 and C21–C34, respectively. Three aromatic compounds were detected by the EPH method in 2B-SD-4 at concentrations of 5.9, 480, and 900 mg/kg for C10–C12, C16–C21, and C21–C34, respectively. Using the VPH method, the aromatics C10–C12 and C12–C13 were detected in both 2B-SD-3 and 2B-SD-4. The concentrations were 11 and 19 mg/kg in 2B-SD-3 and 19 and 53 mg/kg in 2B-SD-4 for C10–C12 and C12–C13, respectively.

9.7 Bioassay Toxicity Testing

Bioassay toxicity testing was completed on all sediment samples collected on July 10, 2001, to assess the effect of the sediments on biota. Toxicity testing generally consisted of exposing aquatic organisms such as midge larvae and amphipods to contaminated sediments from petroleum seeps in the Skykomish River and comparing growth and mortality of these organisms with growth and mortality of organisms exposed to sediments from other parts of the Skykomish River.

Toxicity testing consisted of: (1) *Chironomus tentans* 10-day growth and mortality, (2) *Chironomus tentans* 20-day growth and mortality, (3) *Hyalella azteca* 10-day growth and mortality, and (4) Microtox® as defined by Ecology's 100 percent pore water protocol (P. Adolphson, October 7, 2000). Survival and growth tests of *Chironomus tentans* and *Hyalella azteca* were carried out in accordance with American Society for Testing and Materials (ASTM) protocol E1706 by AMEC Environmental (AMEC) in Fife, Washington (ASTM, 2001). Ecology toxicity testing consisted solely of Microtox®. Results are discussed below.

9.7.1 Midge and Amphipod Toxicity Testing

Table 9-7 summarizes growth and survival results for the 10-day *Hyalella azteca*, 10-day *Chironomus tentans*, and the 20-day *Chironomus tentans* toxicity tests. Figure 9-8 graphically compares the toxicity results between test species and sampling stations. All water quality measurements recorded during the exposure tests were within acceptable ranges defined by the test protocols. No abnormal conditions or behaviors were observed throughout the duration of the test for any of the organisms. Reference toxicant tests were within internal control limits of plus or minus two standard deviations for each test. No objective, freshwater sediment criteria have been established in Washington State (see WAC 173-340-760 and 173-204-340). Criteria for sediment cleanup will be established in the FS based, in part, on bioassay toxicity, and the FS will discuss the relationship between the criteria and area and volume of sediment that may require some form of remedial action. Results of these bioassay tests are described below.

10-day *Hyalella azteca* Growth and Mortality Test

Mean control survival of *Hyalella azteca* was 76 percent, which is slightly below the recommended EPA guideline survival criterion of 80 percent. Average survival of amphipods exposed to the test sediments ranged from 0 to 92 percent. Amphipods exposed to sediment from samples SED-12, SED-13, and SED-14 exhibited lower survival that is statistically significant compared to the reference sediment data (one-tailed t-test, $p < 0.05$). Other samples (SED-10, SED-11, and control) were not statistically different when compared to the reference. Figure 9-7 depicts the TPH concentration and survival of amphipod test organisms with respect to other bioassay survival tests for each sediment sample.

The average growth per organism in the reference sediment was 0.10 mg dry weight (dw). The average growth per surviving organism among the test sediments ranged from 0.06 to 0.08 mg dw. Growth of surviving organisms was reduced in a statistically significant manner compared to the reference only in SED-14. Growth of surviving organisms exposed to SED-10 and SED-11 was not statistically different compared to the reference (SED-12 and SED-13 recorded no growth because all organisms died).

10-day *Chironomus tentans* Growth and Mortality Test

Mean control survival of *Chironomus tentans* was 86 percent, which was above the recommended EPA survival guideline of 70 percent. The mean weight per organism in control sediment was 1.57 mg dw which was above the recommended EPA size guideline of 0.6 mg dw. Average survival of midge larvae exposed to test sediments ranged from 0 to 86 percent. Midge larvae exposed to sediment from samples SED-12 and SED-13 (zero survival) exhibited significantly lower survival when compared to reference sediment data. Growth and survival of organisms exposed to sediments from other

samples (SED-10, SED-11, SED-14, and control) were not significantly different from the reference. Figure 9-8 depicts the TPH concentration and survival of midge larvae test organisms with respect to other bioassay tests for each sediment sample.

The average growth per organism in the reference sediment was 1.33 mg dw. The average growth per organism among the test sediments ranged from 0.45 to 1.11 mg dw. Growth of surviving organisms was reduced in a manner that was statistically significant compared to the reference only in SED-14. Growth of surviving organisms exposed to sediment from other samples (SED-10, SED-11, and control) was not significantly different from the reference.

20-day *Chironomus tentans* Growth and Mortality Test

Mean control survival was 76 percent which was above the EPA guideline survival criterion of 70 percent. The mean weight per organism in control sediment was 0.96 mg dw which was above the recommended EPA size guideline of 0.6 mg dw. Average survival of midge larvae exposed to test sediments ranged from 0 to 82 percent. Midge larvae exposed to sediment from samples SED-12, SED-13, and SED-14 exhibited significantly lower survival when compared to control sediment data. Survival of organisms exposed to samples SED-10 and SED-11 was not significantly different from the reference. Figure 9-8 depicts the TPH concentration and survival of midge larvae test organisms with respect to other bioassay tests for each sediment sample.

The average growth per organism in the reference sediment was 1.36 mg dw. The average growth per organism among the test sediments ranged from 1.11 to 2.04 mg dw. Significant reductions in growth were not detected in organisms exposed to any of the test sediments compared to the reference. However, growth was significantly reduced in the control sediment when compared to the reference.

9.7.2 Microtox® Testing

Microtox® testing was performed for RETEC by AMEC located in Fife, Washington. Ecology's split samples were tested by Parametrix, Inc. Both laboratories followed the 100 percent pore water protocol developed by Peter Adolphson of Ecology; however, AMEC performed the test in a slightly different manner than Parametrix, as described below.

Differences Between Microtox® Test Methods

The methods described in the protocol by Adolphson require that the initial luminescence reading, I_0, be collected 5 minutes following the combination of the bacteria solution and the test solution. A second reading, I_5, is collected 5 minutes later (10 minutes actual elapsed time), and a third reading, I_{15}, is

collected 10 minutes following collection of I_5 (20 minutes actual elapsed time). Parametrix performed the test by these methods.

AMEC collected the initial reading in the bacteria solution prior to the combination with the test solution. Because AMEC considered the test to be initiated when the bacteria and test solutions were mixed, they collected two other readings 5 and 15 minutes following combination. Instead of recording readings at 5, 10, and 20 minutes as performed by Parametrix, AMEC recorded readings at 0, 5, and 15 minutes. AMEC believed they were following Adolphson's protocol correctly. Because of these differences, side-by-side comparisons between AMEC and Parametrix Microtox® results cannot be made; however, several useful interpretations can still be made from both tests.

In the Microtox® test by AMEC, mean luminescence measurements made after the two exposure periods (5-minute and 15-minute actual times) in the reference sediment were not significantly different from the laboratory control samples. Therefore, the reference sediment was used as the control sediment in testing for all other sites. However, if future tests are required then a control sediment will be included opposite each test sample. AMEC analyzed separate reference samples alongside each test and control sample to assure adequate test performance. Microtox® tests by Parametrix for samples SED-12, SED-13, and SED-14 were analyzed alongside one control sample and one reference sediment sample.

Microtox® Results

Results for RETEC and Ecology Microtox® tests are presented in Table 9-8. For test acceptability according to Adolphson's protocol, reference percent output is required to exceed 80 percent at I_5 and 65 percent at I_{15} (10- and 20-minute intervals, respectively). This is calculated by dividing reference output at I_5 (or I_{15}) by that at I_0. Because I_5 (actual 10-minute interval) was not collected by AMEC, the actual 5- and 15-minute intervals were averaged to estimate the actual 10-minute interval. All reference samples being analyzed alongside the test samples and the control exceeded the required 80 percent output. Because I_{15} was not measured by AMEC, it cannot be established whether 65 percent output was met in the reference.

Table 9-8 shows RPD estimates between test and reference samples that are calculated as recommended in the 100 percent pore water Microtox® protocol published by Adolphson to assess biological effects. The Adolphson protocol also states that an RPD greater than 15 percent is a Sediment Quality Standard (SQS) failure and an RPD greater than 25 percent is a Cleanup Screening Level (CSL) failure for the I_5 and I_{15} readings. The RDP percentages referenced in the Adolphson protocol are not specified in the MTCA regulations as cleanup levels for sediments, or in the Sediment Quality Standards, and are presented here for comparison purposes only. Insufficient

pore water was present in sediment sample SED-14 analyzed by AMEC, but sufficient pore water was present in sample SED-14 analyzed by Ecology. Therefore, the Ecology results replace those of AMEC; however, both results are presented. If Adolphson's RDP percentages are used for purposes of comparison, then "CSL failures" occurred in samples SED-12 and SED-13 at I_5 but I_{15} readings were not calculated. Other test samples meet Adolphson's RDP percentage definitions for SQS and CSL (SED-10, SED-11, and SED-14). Using Adolphson's RDP percentages for comparison purposes, Ecology's Microtox® results also indicated "CSL failures" at SED-12 and SED-13 and a "SQS failure" at SED-14 for both the I_5 and I_{15} readings.

Statistical significance is shown in Table 9-9 for RETEC and Ecology Microtox® results. For RETEC results, a statistically significant difference between test sediment and reference sediment is present for the I_5 readings in samples SED-10, SED-12, SED-13, and SED-14. Samples were significantly different from the reference in SED-10, SED-12, and SED-13 for the I_{10} reading. Statistically significant differences exist between test and reference sediment in Ecology's Microtox® test for samples SED-12, SED-13, and SED-14. Significant differences also exist between these test samples and the control results for Ecology's test.

9.7.3 Benthic Toxicity Testing Conclusions

Significant biological effects were observed at SED-12 and SED-13, and a minor effect was observed at SED-14. The in-stream biological effects were localized to SED-12 and SED-13 while downstream samples (located approximately 80 feet away) did not show adverse effects from the benthic species tested. The biological tests had good correlation between species sensitivity and observed response. In four freshwater tests, 100 percent mortality was observed when TPH concentrations met and exceeded 4,300 mg/kg.

Table 9-1 Summary of Diesel and Motor Oil in Sediment

Location ID	Sample Name	Sample Date	Depth Interval (ft)	Analytical Method	TPH-Diesel (mg/kg)		TPH-Motor Oil (mg/kg)	
					DL	Result	DL	Result
Outside Rail Yard								
Surface Zone								
2B-SD-3	2B-SD-3-0-2	1/15/2002	0–2	NWTPHD	5	**35**	10	**110**
3-SD-1	3-SD-1-0-2	1/15/2002	0–2	NWTPHD	5	**54**	10	**150**
5-SD-1	5-SD-1-0-2.5	12/7/2001	0–2.5	NWTPHD	5	**30 J**	10	**42 J**
SED-1	SED-1	10/7/1993	0–0	E418.1	106	BDL	—	—
SED-10	SED-10	7/10/2001	0–0.25	NWTPHD	5	**25**	10	**73**
SED-11	SED-11	7/10/2001	0–0.25	NWTPHD	5	**32**	10	**52**
SED-12	SED-12	7/10/2001	0–0.25	NWTPHD	100	**2,300**	200	**2,000**
SED-13	SED-13	7/10/2001	0–0.25	NWTPHD	860	**48,000**	1,700	**39,000**
SED-14	SED-14	7/10/2001	0–0.25	NWTPHD	5	**180**	10	**180**
SED-16	SED-16	7/10/2001	0–0.25	NWTPHD	5	**7**	10	**35**
SED-2	SED-2	10/7/1993	0–0	E418.1	116	BDL	—	—
SED-3	SED-3	10/7/1993	0–0	E418.1	111	BDL	—	—
SED-4	SED-4	10/7/1993	0–0	E418.1	1,869	**6,900**	—	—
SED-5	SED-5	10/7/1993	0–0	E418.1	117	**990**	—	—
2B-SD-3	2B-SD-3-2.5-5.5	1/15/2002	2.5–5.5	NWTPHD	5	**52**	10	**110**
Smear Zone								
2B-SD-3	2B-SD-3-2.5-5.5	1/15/2002	2.5-5.5	NWTPHD	5	**52**	10	**110**
2B-SD-3	2B-SD-3-5-7.5	1/15/2002	5–7.5	NWTPHD	50	**370**	100	**520**
2B-SD-3	2B-SD-3-7.5-10	1/15/2002	7.5–10	NWTPHD	50	**650**	100	**600**
Saturated Zone								
5-SD-1	5-SD-1-2.5-5	12/7/2001	2.5–5	NWTPHD	5	**6 J**	10	**21 J**
Rail Yard								
Surface Zone								
2B-SD-1	2B-SD-1-0-2.5	12/5/2001	0–2.5	NWTPHD	20	**110 J**	40	**390 J**
2B-SD-1	2B-SD-1EC-2-EcologySplit	12/5/2001	0–2.5	TPHD-NWTPH-DX	—	—	85	**640**
2B-SD-2	2B-SD-2-0-2.5	12/6/2001	0–2.5	NWTPHD	5	**64 J**	10	**170 J**
2B-SD-5	2B-SD-5-0-2.5	12/6/2001	0–2.5	NWTPHD	5	**180 J**	10	**380 J**
2B-SD-6	2B-SD-6-0-2.5	12/5/2001	0–2.5	NWTPHD	5	**9 J**	10	**28 J**
SED-6	SED-6	10/7/1993	0–0	E418.1	145	**97 J**	—	—
SED-7	SED-7	10/7/1993	0–0	E418.1	143	**99 J**	—	—
Smear Zone								
2B-SD-1	2B-SD-1-2.5-5	12/5/2001	2.5–5	NWTPHD	5	**16 J**	10	**60 J**
2B-SD-4	2B-SD-4-2.5-5	12/6/2001	2.5–5	NWTPHD	30	**1,500 J**	60	**1,700 J**
2B-SD-5	2B-SD-5-2.5-5	12/6/2001	2.5–5	NWTPHD	320	**4,800 J**	640	**4,600 J**
2B-SD-5	2B-SD-5-5-6	12/6/2001	5-5.5	NWTPHD	100	**4,700 J**	200	**6,200 J**
2B-SD-6	2B-SD-6-2.5-5	12/5/2001	2.5–5	NWTPHD	5	**10 J**	10	**38 J**
Saturated Zone								
2B-SD-1	2B-SD-1-5-7.5	12/5/2001	5–7.5	NWTPHD	5	BDL	10	BDL

Notes:
BDL - Below detection limit.
DL - Detection limit.
J - Estimated concentration.
"—" - No data available.

Table 9-2 Summary of Arsenic and Lead in Sediment

Location ID	Sample Name	Sample Date	Depth Interval (ft)	Arsenic (mg/kg)		Lead (mg/kg)	
				DL	Result	DL	Result
Outside Rail Yard							
Surface Zone							
2B-SD-3	2B-SD-3-0-2	1/15/2002	0–2	0.8	**12.5**	3	**19**
3-SD-1	3-SD-1-0-2	1/15/2002	0–2	0.6	**10**	2	**69**
5-SD-1	5-SD-1-0-2.5	12/7/2001	0–2.5	0.6	**8.8**	2	**5**
SED-1	SED-1	10/7/1993	0–0	—	**6**	—	**8.3**
SED-2	SED-2	10/7/1993	0–0	—	**50**	—	**6.1**
SED-3	SED-3	10/7/1993	0–0	—	**3**	—	**2.8**
SED-4	SED-4	10/7/1993	0–0	—	**5**	—	**2.7**
SED-5	SED-5	10/7/1993	0–0	—	**2**	—	**4.5**
Smear Zone							
2B-SD-3	2B-SD-3-2.5-5.5	1/15/2002	2.5–5.5	0.6	**3.9**	2	**58**
2B-SD-3	2B-SD-3-5-7.5	1/15/2002	5–7.5	0.6	**2.9**	2	**4**
2B-SD-3	2B-SD-3-7.5-10	1/15/2002	7.5–10	0.5	**2.7**	2	**2**
Saturated Zone							
5-SD-1	5-SD-1-2.5-5	12/7/2001	2.5–5	0.6	**4**	2	**13**
Rail Yard							
Surface Zone							
2B-SD-1	2B-SD-1-M1	12/5/2001	0–2.5	0.8	**13.9 J**	3	**43**
2B-SD-2	2B-SD-2-0-2.5	12/6/2001	0–2.5	0.6	**8.4**	6	**25**
2B-SD-5	2B-SD-5-0-2.5	12/6/2001	0–2.5	0.8	**8.7**	3	**40**
SED-6	SED-6	10/7/1993	0–0	—	**8**	—	**26.8**
SED-7	SED-7	10/7/1993	0–0	—	**20**	—	**64.1**
Smear Zone							
2B-SD-1	2B-SD-1-M2	12/5/2001	2.5–5	0.7	**8.3 J**	3	**8**
2B-SD-2	2B-SD-2-2.5-5	12/6/2001	2.5–5	0.6	**5.7**	2	**6**
2B-SD-4	2B-SD-4-2.5-5	12/6/2001	2.5–5	0.6	**6**	3	**15**
2B-SD-5	2B-SD-5-2.5-5	12/6/2001	2.5–5	0.7	**5.6**	3	**15**
Saturated Zone							
2B-SD-1	2B-SD-1-M3	12/5/2001	5–7.5	0.3	**1.9 J**	2	**4**

Notes:
DL - Detection limit.
J - Estimated concentration.
"—" - No data available.

Table 9-3 Summary of PCBs in Sediment

Location ID	Sample Name	Sample Date	Depth Interval (ft)	Aroclor 1016 (mg/kg)		Aroclor 1221 (mg/kg)		Aroclor 1232 (mg/kg)		Aroclor 1242 (mg/kg)		Aroclor 1248 (mg/kg)		Aroclor 1254 (mg/kg)		Aroclor 1260 (mg/kg)	
				DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Outside Rail Yard																	
Surface Zone																	
2B-SD-3	2B-SD-3-0-2	1/15/2002	0–2	0.055	BDL	0.11	BDL	0.055	BDL	0.055	BDL	0.055	BDL	0.055	BDL	0.055	BDL
3-SD-1	3-SD-1-0-2	1/15/2002	0–2	0.039	BDL	0.077	BDL	0.039	BDL	0.039	BDL	0.039	BDL	0.039	BDL	0.039	BDL
5-SD-1	5-SD-1-0-2.5	12/7/2001	0–2.5	0.042	BDL	0.084	BDL	0.042	BDL	0.042	BDL	0.042	BDL	0.042	BDL	0.042	BDL
SED-1	SED-1	10/7/1993	0–0	0.085	BDL	0.085	BDL	0.085	BDL	0.085	BDL	0.085	BDL	0.17	BDL	0.17	BDL
SED-2	SED-2	10/7/1993	0–0	0.092	BDL	0.092	BDL	0.092	BDL	0.092	BDL	0.092	BDL	0.185	BDL	0.185	BDL
SED-3	SED-3	10/7/1993	0–0	0.089	BDL	0.089	BDL	0.089	BDL	0.089	BDL	0.089	BDL	0.177	BDL	0.177	BDL
SED-4	SED-4	10/7/1993	0–0	0.093	BDL	0.093	BDL	0.093	BDL	0.093	BDL	0.093	BDL	0.187	BDL	0.187	BDL
SED-5	SED-5	10/7/1993	0–0	0.093	BDL	0.093	BDL	0.093	BDL	0.093	BDL	0.093	BDL	0.187	BDL	0.187	BDL
Smear Zone																	
2B-SD-3	2B-SD-3-2.5-5.5	1/15/2002	2.5–5.5	0.038	BDL	0.075	BDL	0.038	BDL	0.038	BDL	0.038	BDL	0.038	BDL	0.038	BDL
2B-SD-3	2B-SD-3-5-7.5	1/15/2002	5–7.5	0.037	BDL	0.074	BDL	0.037	BDL	0.037	BDL	0.037	BDL	0.037	BDL	0.037	BDL
2B-SD-3	2B-SD-3-7.5-10	1/15/2002	7.5–10	0.038	BDL	0.075	BDL	0.038	BDL	0.038	BDL	0.038	BDL	0.038	BDL	0.038	BDL
Saturated Zone																	
5-SD-1	5-SD-1-2.5-5	12/7/2001	2.5–5	0.037	BDL	0.074	BDL	0.037	BDL	0.037	BDL	0.037	BDL	0.037	BDL	0.037	BDL
Rail Yard																	
Surface Zone																	
2B-SD-1	2B-SD-1-P1	12/5/2001	0–2.5	0.057	BDL	0.12	BDL	0.057	BDL	0.057	BDL	0.057	BDL	0.057	BDL	0.057	BDL
2B-SD-1	2B-SD-1EC-2-EcologySplit	12/5/2001	0–2.5	0.0084	BDL	0.0084	BDL	0.0084	BDL	0.0084	BDL	0.0084	BDL	0.0084	**0.0035 NJ**	0.0084	**0.0038 J**
2B-SD-2	2B-SD-2-0-2.5	12/6/2001	0–2.5	0.044	BDL	0.087	BDL	0.044	BDL	0.044	BDL	0.044	BDL	0.044	BDL	0.044	BDL
SED-6	SED-6	10/7/1993	0–0	0.116	BDL	0.116	BDL	0.116	BDL	0.116	BDL	0.116	BDL	0.232	BDL	0.232	BDL
SED-7	SED-7	10/7/1993	0–0	0.114	BDL	0.114	BDL	0.114	BDL	0.114	BDL	0.114	BDL	0.229	BDL	0.229	BDL
Smear Zone																	
2B-SD-1	2B-SD-1-P2	12/5/2001	2.5–5	0.048	BDL	0.096	BDL	0.048	BDL	0.048	BDL	0.048	BDL	0.048	BDL	0.048	BDL
2B-SD-2	2B-SD-2-2.5-5	12/6/2001	2.5–5	0.04	BDL	0.079	BDL	0.04	BDL	0.04	BDL	0.04	BDL	0.04	BDL	0.04	BDL
Saturated Zone																	
2B-SD-1	2B-SD-1-P3	12/5/2001	5–7.5	0.04	BDL	0.08	BDL	0.04	BDL	0.04	BDL	0.04	BDL	0.04	BDL	0.04	BDL

Notes:
BDL - Below detection limit.
DL - Detection limit.
J - Estimated concentration.
N - Estimated concentration based on presumptive evidence.

Table 9-4 Summary of PAH in Sediment

Location ID	Sample Name	Sample Date	Depth Interval (ft)	Acenaphthene (mg/kg)		Acenaphthylene (mg/kg)		Anthracene (mg/kg)		Benzo(a)-anthracene (mg/kg)		Benzo(a)pyrene (mg/kg)		Benzo(b)-fluoranthene (mg/kg)		Benzo(g,h,i)-perylene (mg/kg)		Benzo(k)-fluoranthene (mg/kg)	
				DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Outside Rail Yard																			
Surface Zone																			
SED-1	SED-1	10/7/1993	0- 0	1.051	BDL	1.051	BDL	1.051	BDL	1.051	BDL	1.051	BDL	1.051	BDL	1.051	BDL	1.051	BDL
SED-2	SED-2	10/7/1993	0- 0	0.382	BDL	0.382	BDL	0.382	BDL	0.382	BDL	0.382	BDL	0.382	BDL	0.382	BDL	0.382	BDL
SED-3	SED-3	10/7/1993	0- 0	0.365	BDL	0.365	BDL	0.365	BDL	0.365	BDL	0.365	BDL	0.365	BDL	0.365	BDL	0.365	BDL
SED-4	SED-4	10/7/1993	0- 0	3.855	BDL	3.855	BDL	3.855	BDL	3.855	BDL	3.855	BDL	3.855	BDL	3.855	BDL	3.855	BDL
SED-5	SED-5	10/7/1993	0- 0	2.31	BDL	2.31	BDL	2.31	BDL	2.31	BDL	2.31	BDL	2.31	BDL	2.31	BDL	2.31	BDL
Smear Zone																			
2B-SD-3	2B-SD-3-7.5-10	1/15/2002	7.5- 10	0.0075	BDL	0.0075	BDL	0.0075	BDL	0.0075	BDL	0.0075	BDL	0.0075	**0.01 J**	0.0075	BDL	0.0075	**0.018 J**
Rail Yard																			
Surface Zone																			
2B-SD-1	2B-SD-1EC-2-EcologySplit	12/5/2001	0- 2.5	0.014	**0.0083 J**	0.014	**0.0089 J**	0.014	**0.028 J**	0.014	**0.055**	0.014	**0.064 J**	0.014	**0.168**	0.014	**0.096**	0.014	**0.071**
SED-6	SED-6	10/7/1993	0- 0	1.91	BDL	1.91	BDL	1.91	BDL	1.91	BDL	1.91	BDL	1.91	BDL	1.91	BDL	1.91	BDL
SED-7	SED-7	10/7/1993	0- 0	9.442	BDL	9.442	BDL	9.442	BDL	9.442	BDL	9.442	BDL	9.442	BDL	9.442	BDL	9.442	BDL
Smear Zone																			
2B-SD-4	2B-SD-4-2.5-5	12/6/2001	2.5- 5	0.03	**0.41**	0.03	BDL	0.03	**0.86**	0.03	**1.1**	0.03	**0.96**	0.03	**0.25 J**	0.03	**0.21**	0.03	**0.41 J**
2B-SD-5	2B-SD-5-2.5-5	12/6/2001	2.5- 5	0.033	BDL	0.033	BDL	0.033	**0.1 J**	0.033	**0.059**	0.033	BDL	0.16	BDL	0.033	BDL	0.23	BDL

Notes:
BDL - Below detection limit.
DL - Detection limit.
J - Estimated concentration.

Table 9-4 Summary of PAH in Sediment

Location ID	Sample Name	Sample Date	Depth Interval (ft)	Chrysene (mg/kg)		Dibenz(a,h)-anthracene (mg/kg)		Fluoranthene (mg/kg)		Fluorene (mg/kg)		Indeno-(1,2,3-cd)-pyrene (mg/kg)		Naphthalene (mg/kg)		Phenanthrene (mg/kg)		Pyrene (mg/kg)	
				DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Outside Rail Yard																			
Surface Zone																			
SED-1	SED-1	10/7/1993	0- 0	1.051	BDL	1.051	BDL	1.051	BDL	1.051	BDL	1.051	BDL	1.051	BDL	1.051	BDL	1.051	BDL
SED-2	SED-2	10/7/1993	0- 0	0.382	BDL	0.382	BDL	0.382	BDL	0.382	BDL	0.382	BDL	0.382	BDL	0.382	BDL	0.382	BDL
SED-3	SED-3	10/7/1993	0- 0	0.365	BDL	0.365	BDL	0.365	BDL	0.365	BDL	0.365	BDL	0.365	BDL	0.365	BDL	0.365	BDL
SED-4	SED-4	10/7/1993	0- 0	3.855	BDL	3.855	BDL	3.855	BDL	3.855	BDL	3.855	BDL	3.855	BDL	3.855	BDL	3.855	BDL
SED-5	SED-5	10/7/1993	0- 0	2.31	BDL	2.31	BDL	2.31	BDL	2.31	BDL	2.31	BDL	2.31	BDL	2.31	BDL	2.31	BDL
Smear Zone																			
2B-SD-3	2B-SD-3-7.5-10	1/15/2002	7.5- 10	0.0075	**0.054**	0.0075	BDL	0.0075	BDL	0.0075	BDL	0.0075	BDL	0.0075	BDL	0.0075	BDL	0.0075	**0.017**
Rail Yard																			
Surface Zone																			
2B-SD-1	2B-SD-1EC-2-EcologySplit	12/5/2001	0- 2.5	0.014	**0.133**	0.014	**0.047**	0.014	**0.132**	0.014	**0.0099 J**	0.014	**0.081**	0.014	**0.122**	0.014	**0.149**	0.014	**0.116**
SED-6	SED-6	10/7/1993	0- 0	1.91	BDL	1.91	BDL	1.91	BDL	1.91	BDL	1.91	BDL	1.91	BDL	1.91	BDL	1.91	BDL
SED-7	SED-7	10/7/1993	0- 0	9.442	BDL	9.442	BDL	9.442	BDL	9.442	BDL	9.442	BDL	9.442	BDL	9.442	BDL	9.442	BDL
Smear Zone																			
2B-SD-4	2B-SD-4-2.5-5	12/6/2001	2.5- 5	0.03	**1.6**	0.03	BDL	0.03	**0.49**	0.03	**0.6**	0.03	**0.092**	0.03	BDL	0.03	**2.3**	0.03	**2.8**
2B-SD-5	2B-SD-5-2.5-5	12/6/2001	2.5- 5	0.033	**0.27**	0.033	BDL	0.033	**0.12**	0.033	BDL	0.033	BDL	0.033	BDL	0.033	**0.04**	0.033	**0.24**

Notes:
BDL - Below detection limit.
DL - Detection limit.
J - Estimated concentration.

Table 9-5 Summary of BTEX in Sediment

Location ID	Sample Name	Sample Date	Depth Interval (ft)	Benzene (mg/kg)		Ethylbenzene (mg/kg)		Toluene (mg/kg)		m,p-Xylenes (mg/kg)		o-Xylene (mg/kg)		Total Xylenes (mixed isomers; mg/kg)	
				DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Outside Rail Yard															
Surface Zone															
SED-1	SED-1	10/7/1993	0–0	0.005	BDL	0.005	BDL	0.005	BDL	—	—	—	—	0.005	BDL
SED-2	SED-2	10/7/1993	0–0	0.006	BDL	0.006	BDL	0.006	BDL	—	—	—	—	0.006	BDL
SED-3	SED-3	10/7/1993	0–0	0.006	BDL	0.006	BDL	0.006	BDL	—	—	—	—	0.006	BDL
SED-4	SED-4	10/7/1993	0–0	0.029	BDL	0.029	BDL	0.029	BDL	—	—	—	—	0.029	BDL
SED-5	SED-5	10/7/1993	0–0	0.006	BDL	0.006	BDL	0.006	BDL	—	—	—	—	0.006	BDL
Smear Zone															
2B-SD-3	2B-SD-3-7.5-10	1/15/2002	7.5–10	0.01	BDL	0.5	BDL	0.5	BDL	0.5	BDL	0.5	BDL	—	—
Rail Yard															
Surface Zone															
SED-6	SED-6	10/7/1993	0–0	0.007	BDL	0.007	BDL	0.007	BDL	—	—	—	—	0.007	BDL
SED-7	SED-7	10/7/1993	0–0	0.007	BDL	0.007	BDL	0.007	BDL	—	—	—	—	0.007	BDL
Smear Zone															
2B-SD-4	2B-SD-4-2.5-5	12/6/2001	2.5–5	0.01	BDL	0.5	BDL	0.5	BDL	0.5	BDL	0.5	BDL	—	—

Notes:
BDL - Below detection limit.
DL - Detection limit.

Table 9-6 Summary of EPH/VPH in Sediment

Location ID	Sample Name	Sample Date	Depth Interval (ft)	Analytical Method	Aliphatics													
					C5–C6 Aliphatics (mg/kg)		C6–C8 Aliphatics (mg/kg)		C8–C10 Aliphatics (mg/kg)		C10–C12 Aliphatics (mg/kg)		C12–C16 Aliphatics (mg/kg)		C16–C21 Aliphatics (mg/kg)		C21–C34 Aliphatics (mg/kg)	
					DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Outside Rail Yard																		
Smear Zone																		
2B-SD-3	2B-SD-3-7.5-10	1/15/2002	7.5–10	EPH	—	—	—	—	3.7	BDL	3.7	**10**	3.7	**110**	3.7	**150**	3.7	**390**
2B-SD-3	2B-SD-3-7.5-10	1/15/2002	7.5–10	VPH	5	BDL	5	BDL	5	BDL	5	**10**	—	—	—	—	—	—
Rail Yard																		
Smear Zone																		
2B-SD-4	2B-SD-4-2.5-5	12/6/2001	2.5–5	EPH	—	—	—	—	5.9	**5.9**	5.9	**30**	5.9	**220**	5.9	**270**	5.9	**490**
2B-SD-4	2B-SD-4-2.5-5	12/6/2001	2.5–5	VPH	5	BDL	5	BDL	5	BDL	5	**19**	—	—	—	—	—	—

Notes:
BDL - Below detection limit.
DL - Detection limit.

Table 9-6 Summary of EPH/VPH in Sediment

Location ID	Sample Name	Sample Date	Depth Interval (ft)	Analytical Method	Aromatics											
					C8–C10 Aromatics (mg/kg)		C10–C12 Aromatics (mg/kg)		C12–C13 Aromatics (mg/kg)		C12–C16 Aromatics (mg/kg)		C16–C21 Aromatics (mg/kg)		C21–C34 Aromatics (mg/kg)	
					DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Outside Rail Yard																
Smear Zone																
2B-SD-3	2B-SD-3-7.5-10	1/15/2002	7.5–10	EPH	3.7	BDL	3.7	BDL	—	—	3.7	BDL	3.7	**83**	3.7	**280**
2B-SD-3	2B-SD-3-7.5-10	1/15/2002	7.5–10	VPH	5	BDL	5	**11**	5	**19**	—	—	—	—	—	—
Rail Yard																
Smear Zone																
2B-SD-4	2B-SD-4-2.5-5	12/6/2001	2.5–5	EPH	5.9	BDL	5.9	**5.9**	—	—	5.9	**130**	5.9	**480**	5.9	**900**
2B-SD-4	2B-SD-4-2.5-5	12/6/2001	2.5–5	VPH	5	BDL	5	**19**	5	**53**	—	—	—	—	—	—

Notes:
BDL - Below detection limit.
DL - Detection limit.

Table 9-7 Sediment Bioassay Results

	Control	Sed-10	Sed-11	Sed-12	Sed-13	Sed-14	Reference Sed-16
10-day Hyalella azteca							
Mean % Survival [1]	76	77	92	0	0	64	82
p value (survival)	0.254	0.220	0.054	**< 0.001**	**< 0.001**	**0.008**	—
Mean Weight / Organism (mg)	0.12	0.16	0.15	—	—	0.13	0.17
Mean Growth / Organism (mg) [1]	0.05	0.08	0.08	—	—	0.06	0.10
p value (growth)	**0.003**	0.177	0.075	—	—	**0.006**	—
10-day Chironomus tentans							
Mean % Survival [2]	86	86	78	0	0	64	86
p value (survival)	0.5	0.5	0.259	**< 0.001**	**< 0.001**	0.144	—
Mean Weight / Organism (mg) [2]	0.89	1.33	1.35	—	—	0.69	1.57
Mean Growth / Organism (mg)	0.64	1.08	1.11	—	—	0.45	1.33
p value (growth)	0.013	0.222	0.194	—	—	**0.002**	—
20-day Chironomus tentans							
Mean % Survival	76	82	78	0	0	16	88
p value (survival)	0.132	0.244	0.182	**< 0.001**	**< 0.001**	**< 0.001**	—
Mean Weight / Organism (mg)	0.96	1.30	1.58	—	—	2.22	1.55
Mean Growth / Organism (mg)	0.78	1.11	1.39	—	—	2.04	1.36
p value (growth)	**0.009**	0.146	0.448	—	—	0.298	—

Notes:

[1] ASTM (E1706) test acceptability of 10-day *Hyalella azteca* requires 80 percent control survival and measurable growth in the control sediment.

[2] ASTM (E1706) test acceptability of 10-day *Chironomus tentans* requires 70 percent control survival and mean weight per surviving control organism of 0.6 mg dw.

[a] Significantly greater than reference

Bold and shaded indicates a statistically significant decrease relative to the reference (one tailed t-test, $p<0.05$)

"—" - Not applicable or data not available.

Table 9-8 Summary of RETEC and Ecology Microtox® Test Results

	Reference Mean SED-16 (luminescence, in Microtox® units)					Reference Output (%)			Sample Mean (luminescence, in Microtox® units)					RPD Between Test and Reference Samples (%)			RPD Between RETEC/ Ecology RPD Results (%)	
Measurement Interval (min):	**Initial**	**I_0**	**I_5**	**I_{10}**	**I_{15}**	**I_5**	**I_{10}**	**I_{15}**	**Initial**	**I_0**	**I_5**	**I_{10}**	**I_{15}**	**I_5**	**I_{10}**	**I_{15}**	**I_5**	**I_{15}**
Actual Time Elapsed (min):	**0**	**5**	**10**	**15**	**20**	**10**	**15**	**20**	**0**	**5**	**10**	**15**	**20**	**10**	**15**	**20**	**10**	**20**
RETEC Results																		
Control	91.4	86.8	85.0[a]	83.1	NA	97.9[b]	95.7	NA	93.8	86.9	85.2[a]	83.5	NA	0.2 [b]	-0.5	—	—	—
SED-10	93.5	85.1	83.7[a]	82.2	NA	98.4[b]	96.6	NA	91.6	76.6	75.1[a]	73.5	NA	10.3[b]	10.6	—	—	—
SED-11	90.3	82.0	80.3[a]	78.6	NA	97.9[b]	95.9	NA	90.3	82.8	83.0[a]	83.2	NA	3.4[b]	-5.9	—	—	—
SED-12	93.1	76.9	72.9[a]	68.9	NA	94.8[b]	89.6	NA	93.5	46.9	46.8[a]	46.8	NA	35.8 [b]**	32.1 **	—	—	—
SED-13	89.8	85.1	84.0[a]	82.8	NA	98.7[b]	97.3	NA	89.7	50.2	53.4[a]	56.5	NA	36.4 [b]**	31.8 **	—	—	—
SED-14	95.5	85.7	82.7[a]	79.7	NA	96.5[b]	93.0	NA	93.6	79.8	78.4[a]	76.9	NA	5.2[b]	3.5	—	—	—
Measurement Interval (min):	**Initial**	**I_0**	**I_5**	**I_{10}**	**I_{15}**	**I_5**	**I_{10}**	**I_{15}**	**Initial**	**I_0**	**I_5**	**I_{10}**	**I_{15}**	**I_5**	**I_{10}**	**I_{15}**	**I_5**	**I_{15}**
Actual Time Elapsed (min):	**0**	**5**	**10**	**15**	**20**	**10**	**15**	**20**	**0**	**5**	**10**	**15**	**20**	**10**	**15**	**20**	**10**	**20**
Ecology Results																		
Control	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	—	—	—	NA	NA
SED-10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	—	—	—	NA	NA
SED-11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	—	—	—	NA	NA
SED-12	NA	77.2	77.6	NA	73	100.5	NA	94.1	NA	48.6	50.2	NA	48.4	35.3 **	—	33.7 **	1.4	—
SED-13	NA	77.2	77.6	NA	73	100.5	NA	94.1	NA	34.6	33.4	NA	31.4	57.0 **	—	57.0 **	44.1	—
SED-14	NA	77.2	77.6	NA	73	100.5	NA	94.1	NA	64.4	64.4	NA	60.4	17.0 *	—	17.3 *	106.3	—

Notes:

Reference output should exceed 80 percent at the 5-minute reading and 65 percent at the 15-minute reading.

RPD (Relative Percent Difference) between test and reference results calculated as follows: [100-(test/reference*100)]

RPD between RETEC and Ecology results calculated as follows: $\frac{(|\text{measured value - measured duplicate value}|)}{((\text{measured value + measured duplicate value})/2)} \times 100$

I_0 = initial reading (5 minutes following mixing of bacteria and test solutions).

I_5 = 5-minute reading.

I_{15} = 15-minute reading.

[a] Estimated by averaging I_0 and I_{10} measured values because reading were taken at 5 and 15 minutes actual elapsed time, but not at 10 minutes actual elapsed time.

[b] Reference % Output calculated with estimated values.

NA - Not analyzed.

* Greater than 15% (SQS failure).

** Greater than 25% (CSL failure).

Table 9-9 Sample t-Test Comparisons Assuming Equal Variance of RETEC and Ecology Microtox® Results

	RETEC Results p-value			Ecology Results p-value	
Measurement Interval (min):	**I_0**	**I_5**	**I_{10}**	**I_5**	**I_{15}**
Actual Time Elapsed (min):	**5**	**10**	**15**	**10**	**20**
Reference Comparisons					
Control to Reference	0.471	0.425	0.388	NA	NA
SED-10 to Reference	**< 0.001**	**< 0.001**	**< 0.001**	NA	NA
SED-11 to Reference	0.344	0.084	0.014	NA	NA
SED-12 to Reference	**< 0.001**	**< 0.001**	**< 0.001**	**< 0.001**	**< 0.001**
SED-13 to Reference	**< 0.001**	**< 0.001**	**< 0.001**	**< 0.001**	**< 0.001**
SED-14 to Reference	**0.005**	**0.016**	0.063	**< 0.001**	**< 0.001**
Control Comparisons					
SED-10 to Control	NA	NA	NA	NA	NA
SED-11 to Control	NA	NA	NA	NA	NA
SED-12 to Control	NA	NA	NA	**< 0.001**	**< 0.001**
SED-13 to Control	NA	NA	NA	**< 0.001**	**< 0.001**
SED-14 to Control	NA	NA	NA	**< 0.001**	**< 0.001**

Notes:
NA - Not analyzed.
Bold and shaded indicates a statistically significant reduction (one-tailed t-test, $p<0.05$).